Translation of Japanese Unexamined Pat. Appl. Publication No. 09-018956

Application No.	07-167249
Filing Date	3 July 1995
Publication No.	09-018956
Publication Date	17 January 1997
Int. Cl.[6]	H04Q 7/38; G06F 13/00; G06F 17/30
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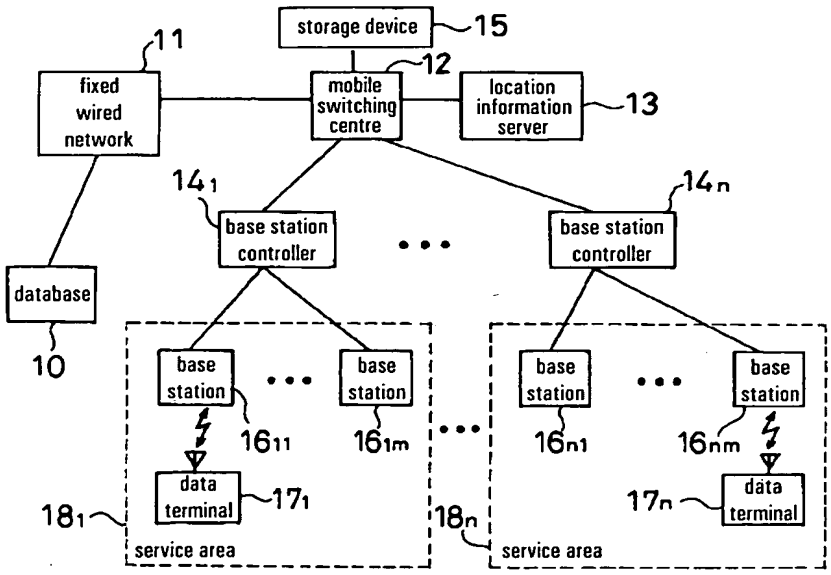
Title Radio Data Communication System

Abstract



TASK: To improve channel utilisation efficiency and database and data terminal processing efficiency in a radio data communication system for data communication between a database and data terminals.

SOLUTION: Storage device(s) 15 is(are) connected to any of mobile switching centre 12, base station controllers 14 and base stations 16 between database 10 and terminals 17 [1]*, and data sent/received between the database and a terminal are buffered, whereby the channel speed between the database and the terminal is adjusted and the utilisation efficiency of the channel is increased. Moreover, when a communication fails, either the mobile switching centre, a base station controller or a base station to which the storage device is connected shares the retry processing, and hence the processing efficiency of the database and the terminal can be improved. [2]

* Numbers in square brackets refer to Translator's Notes appended to the translation.

Claims

1. A radio data communication system comprising a database for providing various services, a fixed wired network housing the database, a mobile switching centre connected to the fixed wired network, a plurality of base station controllers connected to the mobile switching centre and each having a service area for radio communication, a plurality of base stations connected to each base station controller, data terminals connected to base stations and capable of data communication with said database, and a location information server connected to said mobile switching centre and serving to record location information of each data terminal;

said radio data communication system being characterised in that it provides a storage device [3] for retaining data sent from the database towards a data terminal and data sent from a data terminal towards the database.

2. The radio data communication system according to Claim 1, characterised in that the storage device is housed in the mobile switching centre, and when the mobile switching centre receives data from one of either the database or a data terminal it retains this data in the storage device, and transmits this retained data to the other of either the database or the data terminal.

3. The radio data communication system according to Claim 1, characterised in that the storage devices are housed in the base station controllers, and when a base station controller receives data from one of either the database or a data terminal it retains this data in the storage device, and transmits this retained data to the other of either the database or the data terminal.

4. The radio data communication system according to Claim 1, characterised in that the storage devices are housed in the base stations, and when a base station receives data from one of either the database or a data terminal it retains this data in the storage device, and transmits this retained data to the other of either the database or the data terminal.

Detailed Description of the Invention

Technical field of the invention

(1) The present invention relates to a radio data communication system whereby a data terminal and a database communicate data via a radio channel.*

Prior art

(2) In a radio data communication system of this type, when for example a data terminal performs data communication with a database, a first method that can be adopted as the communication procedure is for the data terminal to request a call in advance, whereby a channel is fixedly secured between the data terminal and the database, and data communication with the database is carried out via this channel. A second method that can be adopted is to use multi-channel access, whereby a data terminal can receive radio waves in several channels from a base station. With this method, communication involves selecting an available channel from among these

* Numbers in round brackets at the beginning of paragraphs correspond to the paragraph numbering in the Japanese patent document.

channels. In order to increase channel utilisation rate, the selected channel is disconnected after (for example, 3 minutes after) data have been communicated.

Problems that the invention will solve

(3) A problem that has been encountered with the aforementioned first method is that because the channel is constantly occupied during the data communication, the channel utilisation efficiency decreases. Another problem encountered is that, of the database and the data terminals, it is the database which has the faster processing speed, with the result that during data communication the database processes at a speed matched to that of the data terminals and hence the processing capability of the database experiences a relative decrease. There are two reasons for this. Firstly, as mentioned above, the database has a higher processing speed than the data terminals. Secondly, of the two communication channels (i) database–base station controller–base station, and (ii) base station–data terminal, it is the former which is faster and has the higher capacity.

(4) A further problem encountered is that if the connection between the database and the data terminal fails, the data terminal or the database will issue a call request many times in order to reconnect. Because processing relating to communication procedures between the database and the data terminal is performed each time a call request is issued, this processing increases and consequently the processing efficiency of the database and the data terminal decreases. It is therefore an object of the present invention to improve channel utilisation efficiency and to improve database and data terminal processing efficiency when performing data communication between a database and data terminals.

Means for overcoming problems

(5) To overcome the problems outlined above, the present invention provides a storage device or devices for retaining data sent from a database towards a data terminal and data sent from a data terminal towards the database in a radio data communication system comprising a database for providing various services, a fixed wired network housing the database, a mobile switching centre connected to the fixed wired network, a plurality of base station controllers connected to the mobile switching centre and each having a service area for radio communication, a plurality of base stations connected to each base station controller, data terminals connected by radio to base stations and capable of data communication with the database, and a location information server connected to the mobile switching centre and serving to record location information for each data terminal. Consequently, data transmitted or received between the database and a data terminal is buffered by a storage device, whereby the speed of the channel between the database and the data terminal can be adjusted, with the result that the utilisation efficiency of the channel between the database and the data terminal can be improved and more data can be transmitted and received.

(6) The storage device is housed in the mobile switching centre, and when the mobile switching centre receives data from one of either the database or a data terminal it retains this data in the storage device, and transmits this retained data to the other of either the database or the data terminal. As a result, it becomes possible to likewise increase the utilisation efficiency of the channel between the database and the data

terminal. Moreover, when data communication between the database and a data terminal fails, the retry processing and other communication processing performed by the database and the data terminal for reconnection is taken over by the mobile switching centre, and hence the processing efficiency of the database and the data terminal can be improved. Alternatively, storage devices are housed in the base station controllers, and when a base station controller receives data from one of either the database or a data terminal it retains this data in the storage device, and transmits this retained data to the other of either the database or the data terminal. As a result, in similar manner, the utilisation efficiency of the channel between the database and the data terminal can be improved and the processing efficiency of the database and the data terminal can be improved. Alternatively, storage devices are housed in the base stations, and when a base station receives data from one of either the database or a data terminal it retains this data in the storage device, and transmits this retained data to the other of either the database or the data terminal. As a result, in similar manner, the utilisation efficiency of the channel between the database and the data terminal can be improved and the processing efficiency of the database and the data terminal can be improved.

Modes of embodying the invention

(7) The present invention will now be described with reference to the accompanying drawings. FIG. 1 is a block diagram showing a first mode of embodying the radio data communication system of the present invention. In this figure, numeral 10 references a database for providing various services, numeral 11 references a fixed wired network to which database 10 is connected, numeral 12 references a mobile switching centre connected to fixed wired network 11, numeral 13 references a location information server for recording location information of the data terminals identified below, numerals 14_1–14_n reference base station controllers connected to mobile switching centre 12 [4], numeral 15 references a storage device connected to mobile switching centre 12, numerals 16_{11}–16_{1m} and 16_{n1}–16_{nm} reference base stations connected to base station controllers 14, numerals 17_1–17_n reference data terminals for radio communication with base stations 16, and numerals 18_1–18_n reference the service areas covered by base station controllers 14.

(8) Next, the operation of the system shown in FIG. 1 will be described on the basis of the sequence diagrams of FIG. 4 and FIG. 5. Firstly, the operation when transmitting data from database 10 to a data terminal 17 will be described on the basis of the sequence diagram of FIG. 4. When database 10 has made a call request to fixed wired network 11 for a call to a data terminal 17 and has placed a call to data terminal 17 (step S1), mobile switching centre 12 located between fixed wired network 11 and data terminal 17 intercepts this call based on this call request and sends back a "provisional connection" response to database 10 (step S2). Namely, in this case, irrespective of whether or not database 10 and data terminal 17 can be connected, mobile switching centre 12 can immediately send back a connection response to database 10, with the result that database 10 does not have to repeat the call request and other reconnection processing.

(9) When database 10 has received the "provisional connection" response, it responds to a "provisional data transfer" request from mobile switching centre 12 (step S3) by transmitting data to data terminal 17 (step S4). Mobile switching centre 12

temporarily retains this transmitted data in storage device 15, sends back a "provisional data transfer completed" response to database 10 (step S5), and disconnects the channel. Because the wired network between database 10 and mobile switching centre 12 is faster than the channel between data terminal 17 and mobile switching centre 12, data can be transmitted and received in a shorter time than if it were being transmitted and received between database 10 and data terminal 17. As a result, the utilisation efficiency of the channel between database 10 and mobile switching centre 12 is improved.

(10) In order to transmit to data terminal 17 the data that have been temporarily retained in storage device 15, mobile switching centre 12 fetches location information for the relevant data terminal 17 from location information server 13, and performs call request processing for placing a call to data terminal 17 via the relevant base station controller 14 and base station 16 (step S6). If the connection to data terminal 17 fails, mobile switching centre 12 performs the processing required for reconnection to data terminal 17. Accordingly, communication procedures and processing needed for reconnection are not required in database 10, and the load on the database is lessened.

(11) When the call request processing by mobile switching centre 12 is completed and a channel is connected to data terminal 17 (step S7), mobile switching centre 12 reads the data in storage device 15 and transmits it to data terminal 17 (step S8). When data terminal 17 has received all the data, it sends back a "data receiving completed" response and immediately disconnects the channel (step S9). When this "data receiving completed" response is received by mobile switching centre 12, the mobile switching centre makes a call request to fixed wired network 11 for a call to database 10, reconnects to the database, and transmits an "all processing completed" response to database 10 (step S10). When database 10 receives this "all processing completed" response, it knows that the data have been correctly transmitted.

(12) Next, the operation when transmitting data from a data terminal 17 to database 10 will be described on the basis of the sequence diagram of FIG. 5. Firstly, when a data terminal 17 has made a call request to a base station 16 for a call to database 10 and has sent the call (step S11), a call signal from base station 16 based on this call request reaches mobile switching centre 12 via a base station controller 14. Mobile switching centre 12 intercepts this call signal and sends back a "provisional connection" response to data terminal 17 (step S12), just as if a connection had been successfully made to database 10. Namely, irrespective of whether or not data terminal 17 and database 10 can be connected, mobile switching centre 12 can immediately send back a connection response to data terminal 17. Consequently, data terminal 17 can behave as if it is always connected to database 10, regardless of the operating condition of database 10, and therefore the load due to retry processing (reconnection processing) etc. is lessened.

(13) Data terminal 17 which has received the "provisional connection" response transmits data to database 10 (step S13). This transmitted data is received by mobile switching centre 12 and temporarily retained in storage device 15. At this point, mobile switching centre 12 sends back to data terminal 17 a "provisional data transfer completed" response (step S14) and disconnects the channel. Next, in order to

transmit to database 10 the data that have been temporarily retained in storage device 15, mobile switching centre 12 makes a call request to fixed wired network 11 for a call to database 10 and connects the channel to database 10 (step S15).

(14) When a connection response to this call request is sent back from database 10 (step S16), mobile switching centre 12 reads the data in storage device 15 and transmits it to database 10 (step S17). When database 10 has received all the data, it sends back a "data receiving completed" response and immediately disconnects the channel (step S18). Because the channel between database 10 and mobile switching centre 12 is faster than the channel between mobile switching centre 12 and data terminal 17, data can be transferred at a higher rate than if the data communication had been performed by establishing a connection between database 10 and data terminal 17. As a result, the occupancy of the channel between database 10 and mobile switching centre 12 decreases and consequently the channel can be used more efficiently. When mobile switching centre 12 receives the "data receiving completed" response from database 10, it reconnects to data terminal 17 and transmits an "all processing completed" response (step S19). When data terminal 17 receives this "all processing completed" response, it knows that the data have been correctly transmitted.

(15) Thus in the first embodiment, from the point of view of database 10 it seems that the database can always be connected to data terminal 17 and that the data transmit/receive rate of data terminal 17 has become higher. As a result, the utilisation efficiency of the channel between database 10 and mobile switching centre 12 can be improved and the load on database 10 due to retry processing etc. is lessened. From the point of view of data terminal 17, it seems that it is always connected to database 10, with the result that the load due to retry processing etc. is lessened.

(16) FIG. 2 is a block diagram showing a second mode of embodying the radio data communication system of the present invention. Whereas in the radio data transmission system shown in FIG. 1 storage device 15 was connected to mobile switching centre 12, in this second embodiment storage devices 15_1–15_n are connected to respective base station controllers 14_1–14_n. The operation of the system shown in FIG. 2 will now be described on the basis of the sequence diagrams of FIG. 6 and FIG. 7.

(17) Firstly, the operation when transmitting data from database 10 to a data terminal 17 will be described on the basis of the sequence diagram of FIG. 6. When database 10 has made a call request and placed a call to a data terminal 17 (step S21), mobile switching centre 12, which has detected the call to data terminal 17 via fixed wired network 11, infers, from location information server 13 [5], location information for the terminal 17 in question and designates an applicable base station controller 14. Base station controller 14 that has been designated and that is located between the data terminal 17 in question and database 10, intercepts the call based on the call request, and sends back a "provisional connection" response to database 10 (step S22). At this point in time, it is irrelevant whether or not a connection can be established to data terminal 17, and therefore a connection response can be sent back immediately and database 10 does not have to perform reconnection processing.

(18) When database 10 has received the "provisional connection" response, it attempts to transmit data to data terminal 17 (steps S23 and S24). Base station controller 14 temporarily retains this transmitted data in storage device 15, sends back a "provisional data transfer completed" response to database 10 (step S25), and disconnects the channel. Because the wired channel between database 10 and base station controller 14 is faster than the channel between data terminal 17 and base station controller 14, data can be transmitted and received in a shorter time than if it were being transmitted and received between database 10 and data terminal 17. As a result, the utilisation efficiency of the channel between database 10 and base station controller 14 is improved.

(19) In order to transmit to data terminal 17 the data that have been temporarily retained in storage device 15, base station controller 14 performs call request processing for placing a call to data terminal 17 via the relevant base station 16 (step S26). If the connection to data terminal 17 fails, base station controller 14 performs the processing required for reconnection to data terminal 17. Accordingly, reconnection processing by database 10 becomes unnecessary and the load on database 10 is lessened.

(20) When the call request processing by base station controller 14 is completed and a channel is connected to data terminal 17, base station controller 14 reads the data in storage device 15 and transmits it to data terminal 17 (steps S27 and S28). When data terminal 17 has received all the data, it sends back a "data receiving completed" response and immediately disconnects the channel (step S29). When database 10 receives an "all processing completed" response based on this "data receiving completed" response, it knows that the data have been transmitted correctly (step S30).

(21) Next, the operation when transmitting data from a data terminal 17 to database 10 in the system shown in FIG. 2 will be described on the basis of the sequence diagram of FIG. 7. Firstly, when a data terminal 17 has made a call request and has placed a call to database 10 (step S31), base station controller 14 intercepts the call signal that is output from a base station 16 and sends back to data terminal 17 via the base station 16 a "provisional connection" response (step S32), just as if a connection had been successfully made to database 10. At this point in time, because it is irrelevant whether or not a connection can be made to database 10, a connection response can be sent back immediately. Consequently, data terminal 17 can behave as if it is always connected to database 10, regardless of the operating condition of database 10, and therefore the load due to retry processing etc. is lessened.

(22) Data terminal 17 which has received the "provisional connection" response transmits data for database 10 (step S33). Base station controller 14 temporarily retains this transmitted data in storage device 15, sends back a "provisional data transfer completed" response to data terminal 17 (step S34) and disconnects the channel. In order to transmit to database 10 the data that have been temporarily retained in storage device 15, base station controller 14 makes a call request to database 10 and connects the channel (step S35).

(23) When a connection response to this call request is sent back from database 10 (step S36), base station controller 14 reads the data in storage device 15 and

transmits it to database 10 (step S37). When database 10 has received all the data, it sends back a "data receiving completed" response and immediately disconnects the channel (step S38). Because the channel between database 10 and base station controller 14 is faster than the channel between base station controller 14 and data terminal 17, data can be transferred at a higher rate than if the data communication had been performed by establishing a connection between database 10 and data terminal 17. As a result, the occupancy of the channel between database 10 and base station controller 14 decreases and the channel can be used more efficiently. When base station controller 14 receives the "data receiving completed" response from database 10, it reconnects to data terminal 17, transmits an "all processing completed" response (step S39), and after this immediately disconnects the channel. When data terminal 17 receives this "all processing completed" response, it knows that the data have been correctly transmitted.

(24) Thus in the second embodiment, from the point of view of database 10 it seems that it can always be connected to data terminal 17 and that the data transmit/receive rate of data terminal 17 has become higher. As a result, the utilisation efficiency of the channel between database 10 and base station controller 14 can be improved and the load on database 10 due to retry processing etc. is lessened. From the point of view of data terminal 17, it seems that it is always connected to database 10, with the result that the load due to retry processing etc. is lessened.

(25) FIG. 3 is a block diagram showing a third mode of embodying the radio data communication system of the present invention. Whereas in the systems depicted in FIG. 1 and FIG. 2 the storage device or devices were connected to either mobile switching centre 12 or to base station controllers 14, in this third embodiment storage devices 15_{11}–15_{1m} and 15_{n1}–15_{nm} are connected to respective base stations 16_{11}–16_{1m} and 16_{n1}–16_{nm}. The operation of the system depicted in FIG. 3 will now be described on the basis of the sequence diagrams of FIG. 8 and FIG. 9.

(26) Firstly, the operation when transmitting data from database 10 to a data terminal 17 will be described on the basis of the sequence diagram of FIG. 8. When database 10 has requested a call to a data terminal 17 (step S41), mobile switching centre 12 infers, from location information server 13 [6], location information for the terminal 17 in question and designates an applicable base station controller 14 and base station 16. Base station 16 that has been designated and that is located between the data terminal 17 in question and database 10, intercepts the call request and sends back a "provisional connection" response to database 10 (step S42). At this point in time, it is irrelevant whether or not a connection can be established to data terminal 17, and therefore a connection response can be sent back immediately and there is no need to perform call request processing again.

(27) When database 10 has received the "provisional connection" response, it attempts to transmit data to data terminal 17 (steps S43 and S44). The relevant base station 16 temporarily retains this transmitted data in storage device 15, sends back a "provisional data transfer completed" response to database 10 (step S45), and disconnects the channel. Because the wired channel between database 10 and the relevant base station 16 is faster than the radio channel between data terminal 17

and the relevant base station 16, data can be transmitted and received in a shorter time than if it were being transmitted and received between database 10 and data terminal 17. As a result, the utilisation efficiency of the channel between database 10 and the relevant base station 16 can be improved.

(28) In order to transmit to data terminal 17 the data that have been temporarily retained in storage device 15, base station 16 performs call request processing for placing a call to the relevant data terminal 17 (step S46). If the connection to data terminal 17 fails, the relevant base station 16 performs the processing required for reconnection to data terminal 17, and therefore reconnection processing by database 10 becomes unnecessary and the load on database 10 is lessened.

(29) When the call request processing by base station 16 is completed and a channel is connected to data terminal 17, base station 16 reads the data in storage device 15 and transmits it to data terminal 17 (steps S47 and S48). When data terminal 17 has received all the data, it sends back a "data receiving completed" response and immediately disconnects the channel (step S49). When database 10 receives an "all processing completed" response based on this "data receiving completed" response, it knows that the data have been correctly transmitted (step S50).

(30) Next, the operation when transmitting data from a data terminal 17 to database 10 in the system depicted in FIG. 3 will be described on the basis of the sequence diagram of FIG. 9. Firstly, when a data terminal 17 has made a call request and has placed a call to database 10 (step S51), the relevant base station 16 present at this time intercepts this call request and sends back to data terminal 17 a "provisional connection" response (step S52), as if a connection had been successfully made to database 10. At this point in time, because it is irrelevant whether or not a connection can be made to database 10, a connection response can be sent back immediately. Consequently, data terminal 17 can behave as if it is always connected to database 10, regardless of the operating condition of database 10, and therefore the load due to retry processing etc. is lessened.

(31) Data terminal 17 which has received the "provisional connection" response transmits data for database 10 (step S53). The relevant base station 16 temporarily retains this transmitted data in storage device 15, sends back a "provisional data transfer completed" response to data terminal 17 (step S54) and disconnects the channel. In order to transmit to database 10 the data that have been temporarily retained in storage device 15, base station 16 makes a call request to database 10 via base station controller 14 and mobile switching centre 12, and connects the channel (step S55).

(32) When a connection response to this call request is sent back from database 10 (step S56), base station 16 reads the data in storage device 15 and transmits it to database 10 (step S57). When database 10 has received all the data, it sends back a "data receiving completed" response and immediately disconnects the channel (step S58). Because the channel between database 10 and the relevant base station 16 is faster than the radio channel between the relevant base station 16 and data terminal 17, data can be transferred at a higher rate than if the data communication had been performed by establishing a connection between database 10 and data terminal 17. As a result, the occupancy of the channel between database 10 and the relevant base

station 16 decreases and the channel can be used more efficiently. When base station 16 receives the "data receiving completed" response from database 10, it reconnects to data terminal 17, transmits an "all processing completed" response (step S59), and after this immediately disconnects the channel. When data terminal 17 receives this "all processing completed" response, it knows that the data have been correctly transmitted.

(33) Thus in the third embodiment, from the point of view of database 10 it seems that it can always connect to data terminal 17 and that the data transmit/receive rate of data terminal 17 has become higher. As a result, the utilisation efficiency of the channel between database 10 and the relevant base station 16 can be improved and the load on database 10 due to retry processing etc. is lessened. From the point of view of data terminal 17, it seems that it is always connected to database 10, with the result that the load due to retry processing etc. is lessened.

(34) As has been explained above, by connecting a storage device or storage devices 15 to any of mobile switching centre 12, base station controllers 14 and base stations 16, which are located between database 10 and data terminals 17, and buffering data transmitted or received between database 10 and a data terminal 17, the channel speed between database 10 and the data terminal 17 can be adjusted, whereby the utilisation efficiency of the communication channel between database 10 and the data terminal 17 can be increased and more data can be transmitted and received. Moreover, because the processing load due to retry processing etc. is shared by mobile switching centre 12, or by a base station controller 14, or by a base station 16, processing efficiency in database 10 and data terminal 17 can be increased.

Effects of the invention

(35) As has been explained above, the present invention provides a storage device or devices for retaining data sent from a database towards a data terminal and data sent from a data terminal towards the database in a radio data communication system comprising a database for providing various services, a fixed wired network housing the database, a mobile switching centre connected to the fixed wired network, a plurality of base station controllers connected to the mobile switching centre and each having a service area for radio communication, a plurality of base stations connected to each base station controller, data terminals connected by radio to the base stations and capable of data communication with the database, and a location information server connected to the mobile switching centre and serving to record location information for each data terminal. Accordingly, data transmitted or received between the database and a data terminal is buffered by a storage device, whereby the speed of the channel between the database and the data terminal can be adjusted, with the result that the utilisation efficiency of the channel between the database and the data terminal can be improved and more data can be transmitted and received.

(36) The storage device is housed in the mobile switching centre, and when the mobile switching centre receives data from one of either the database or a data terminal it retains this data in the storage device, and transmits this retained data to the other of either the database or the data terminal. The utilisation efficiency of the channel between the database and the data terminal can therefore be increased. Moreover, when data communication between the database and a data terminal fails,

the retry processing and other communication processing performed by the database and the data terminal for reconnection is taken over by the mobile switching centre, and hence the processing efficiency of the database and the data terminal can be improved. Alternatively, storage devices are housed in the base station controllers, and when a base station controller receives data from one of either the database or a data terminal it retains this data in the storage device, and transmits this retained data to the other of either the database or the data terminal. As a result, in similar manner, the utilisation efficiency of the channel between the database and the data terminal can be improved and the processing efficiency of the database and the data terminal can be improved. Alternatively, storage devices are housed in the base stations, and when a base station receives data from one of either the database or a data terminal it retains this data in the storage device, and transmits this retained data to the other of either the database or the data terminal. As a result, in similar manner, the utilisation efficiency of the channel between the database and the data terminal can be improved and the processing efficiency of the database and the data terminal can be improved.

Brief Description of the Drawings

FIG. 1 is a block diagram showing a first mode of embodying the radio data communication system of the present invention.

FIG. 2 is a block diagram showing a second mode of embodying the above-mentioned system.

FIG. 3 is a block diagram showing a third mode of embodying the above-mentioned system.

FIG. 4 is a sequence diagram showing the operation of each part in the system depicted in FIG. 1.

FIG. 5 is a sequence diagram showing the operation of each part in the system depicted in FIG. 1.

FIG. 6 is a sequence diagram showing the operation of each part in the system detected in FIG. 2.

FIG. 7 is a sequence diagram showing the operation of each part in the system depicted in FIG. 2.

FIG. 8 is a sequence diagram showing the operation of each part in the system depicted in FIG. 3.

FIG. 9 is a sequence diagram showing the operation of each part in the system depicted in FIG. 3.

Explanation of referencing numerals

10□□□□□□□□□□□□□□□□□□□□□□□□ database
11□□□□□□□□□□□□□□□□□□□□□□□□ fixed wired network
12□□□□□□□□□□□□□□□□□□□□□□□□ mobile switching centre
13□□□□□□□□□□□□□□□□□□□□□□□□ location information server
14_1–14_n □□□□□□□□□□□□□□□□□□□□ base station controllers
15, 15_1–15_n, 15_{11}–15_{1m}, 15_{n1}–15_{nm} □□ storage devices
16_{11}–16_{1m}, 16_{n1}–16_{nm} □□□□□□□□□□ base stations
17_1–17_n □□□□□□□□□□□□□□□□□□□□ data terminals
18_1–18_n □□□□□□□□□□□□□□□□□□□□ service areas

FIG. 1

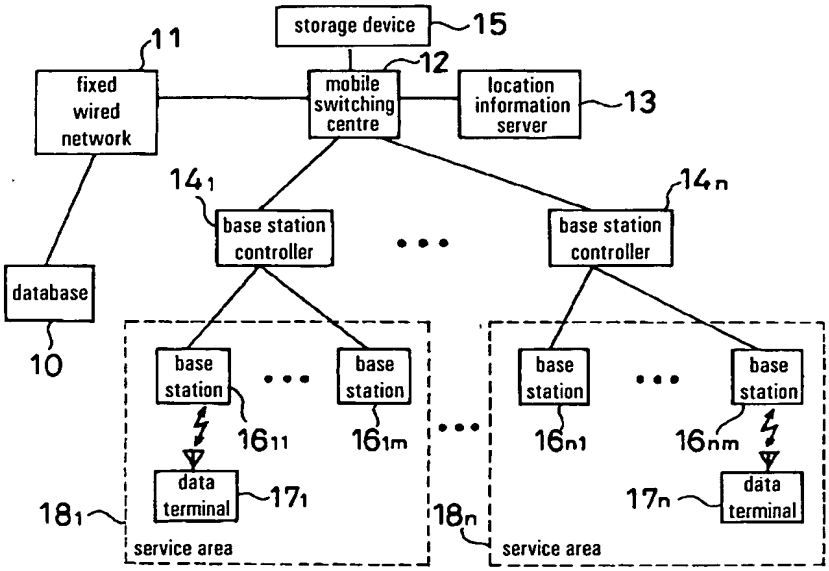


FIG. 2

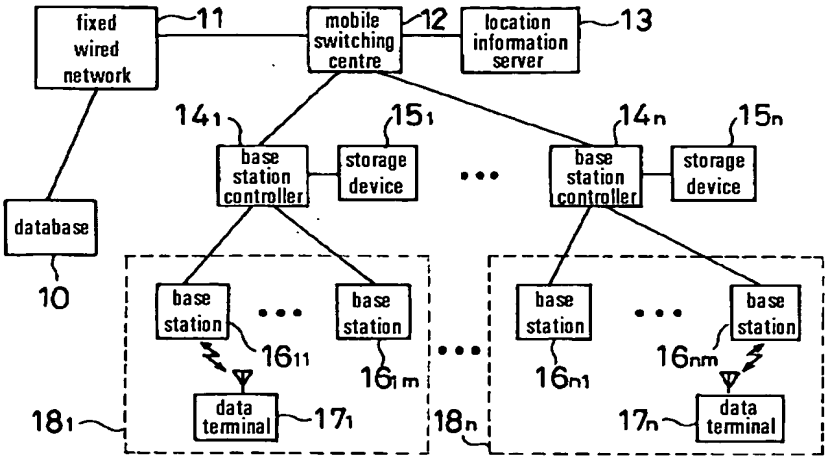

fixed wired network
11
mobile switching centre
12
location information server
13
14₁
15₁
14n
15n
base station controller
storage device
base station controller
storage device
database
10
base station
16₁₁
base station
16₁m
base station
16n1
base station
16nm
data terminal
17₁
data terminal
17n
18₁
18n

FIG. 3

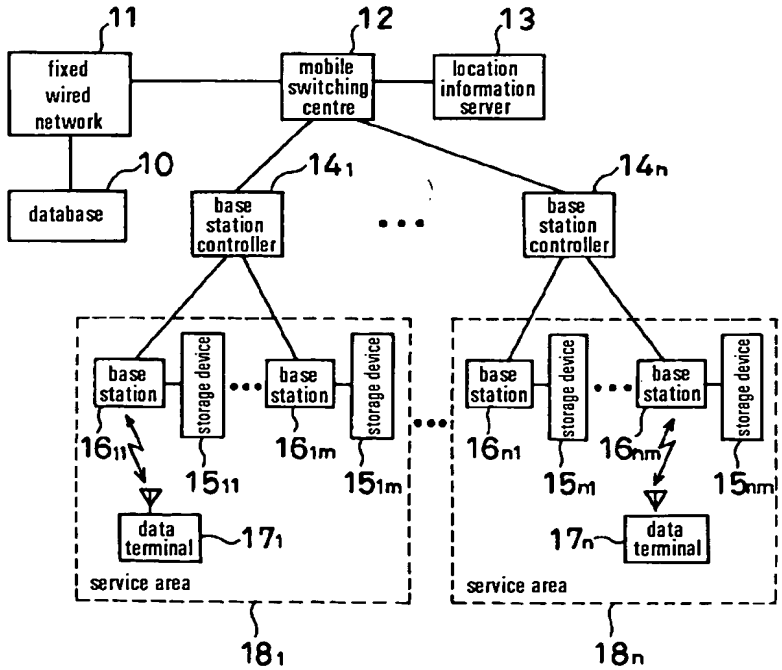

11
12
13
fixed wired network
mobile switching centre
location information server
10
14₁
14n
database
base station controller
base station controller
base station
storage device
base station
storage device
base station
storage device
base station
storage device
16₁₁
16₁m
16n1
16nm
15₁₁
15₁m
15n1
15nm
data terminal
17₁
data terminal
17n
service area
service area
18₁
18n

FIG. 4

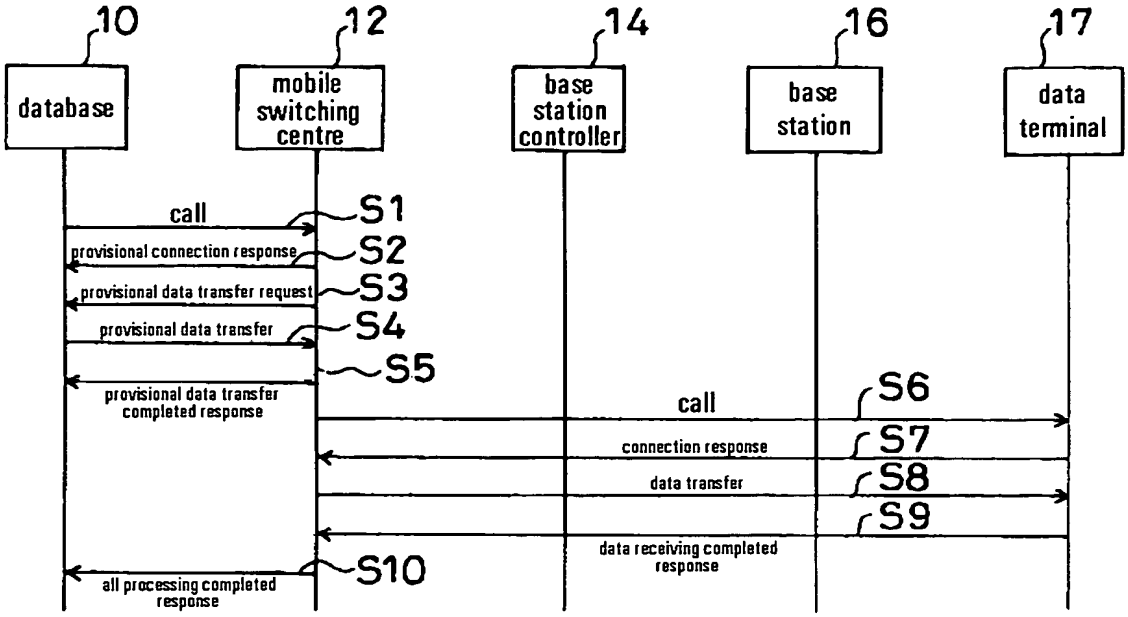

10
12
14
16
17
database
mobile switching centre
base station controller
base station
data terminal
call
S1
provisional connection response
S2
provisional data transfer request
S3
provisional data transfer
S4
S5
provisional data transfer completed response
call
S6
connection response
S7
data transfer
S8
S9
data receiving completed response
S10
all processing completed response

FIG. 5

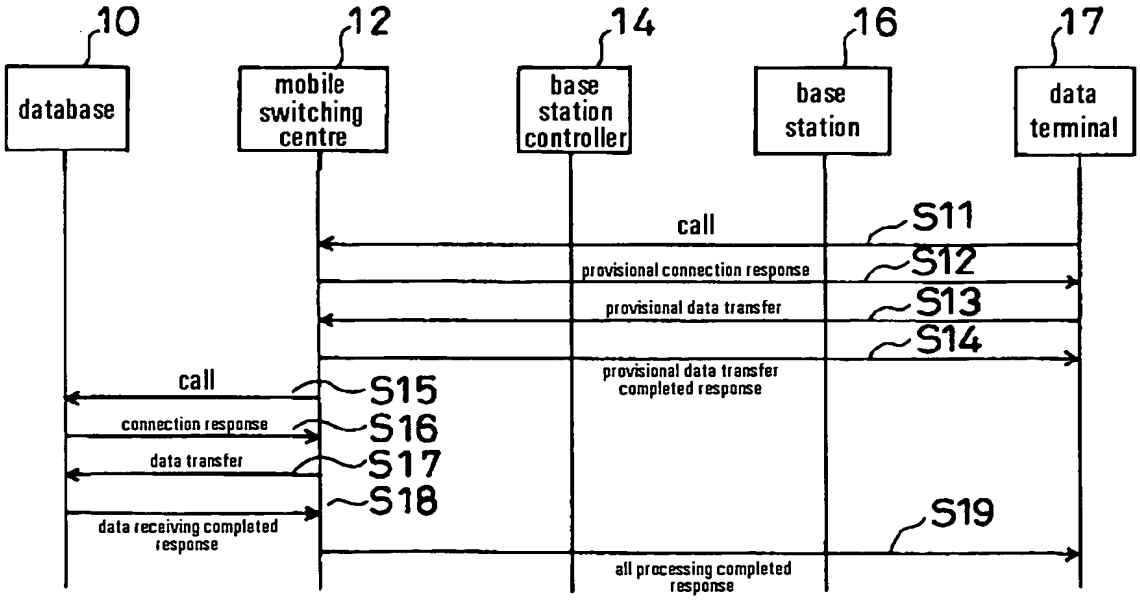

10
12
14
16
17
database
mobile switching centre
base station controller
base station
data terminal
call
S11
provisional connection response
S12
provisional data transfer
S13
S14
provisional data transfer completed response
call
S15
connection response
S16
data transfer
S17
S18
data receiving completed response
S19
all processing completed response

FIG. 6

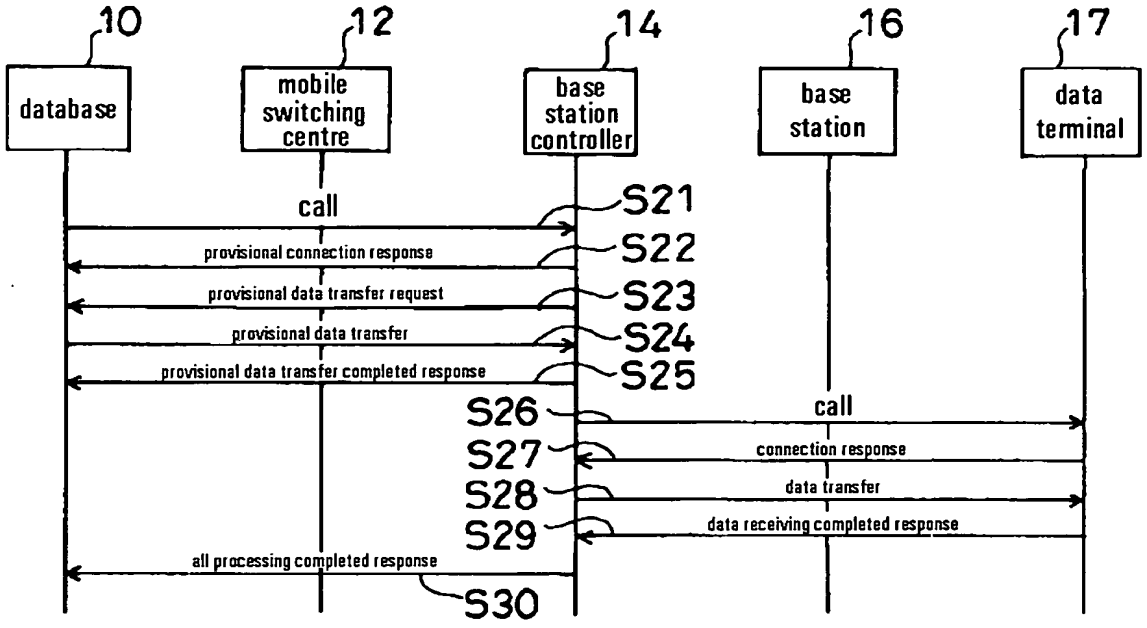

10
12
14
16
17
database
mobile switching centre
base station controller
base station
data terminal
call
S21
provisional connection response
S22
provisional data transfer request
S23
provisional data transfer
S24
provisional data transfer completed response
S25
S26
call
S27
connection response
S28
data transfer
S29
data receiving completed response
all processing completed response
S30

FIG. 7

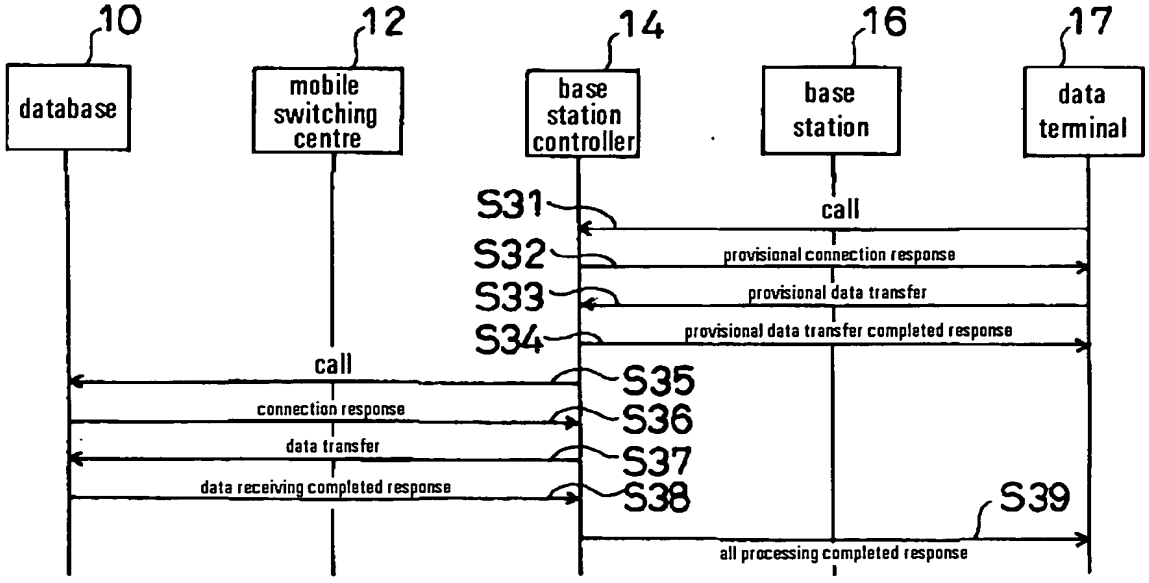

10
12
14
16
17
database
mobile switching centre
base station controller
base station
data terminal
S31
call
S32
provisional connection response
S33
provisional data transfer
S34
provisional data transfer completed response
call
S35
connection response
S36
data transfer
S37
data receiving completed response
S38
S39
all processing completed response

FIG. 8

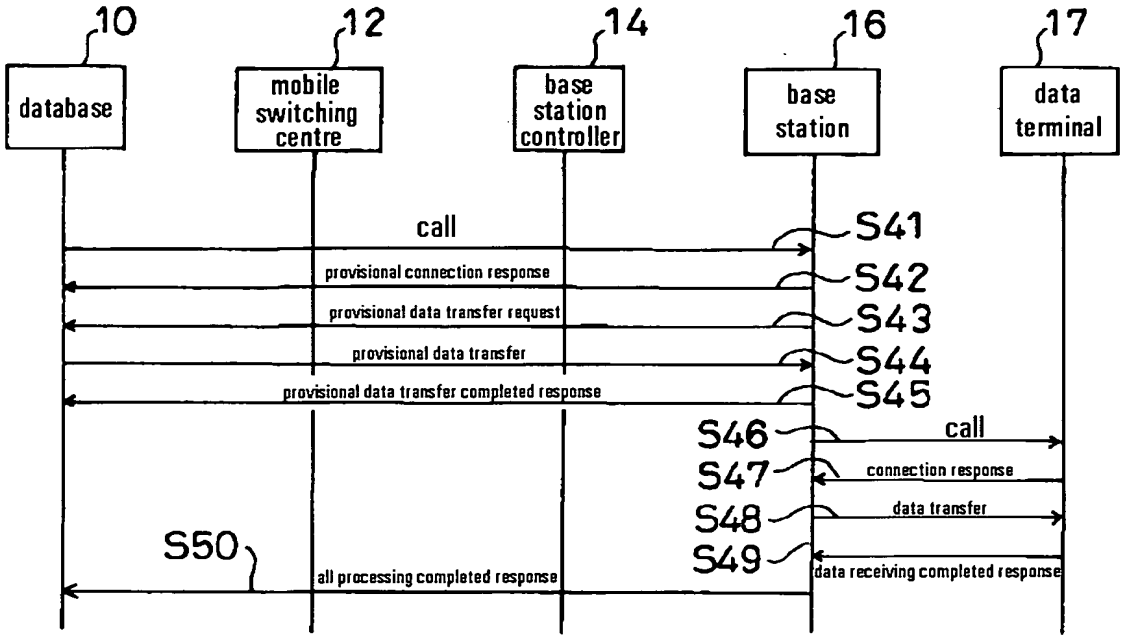
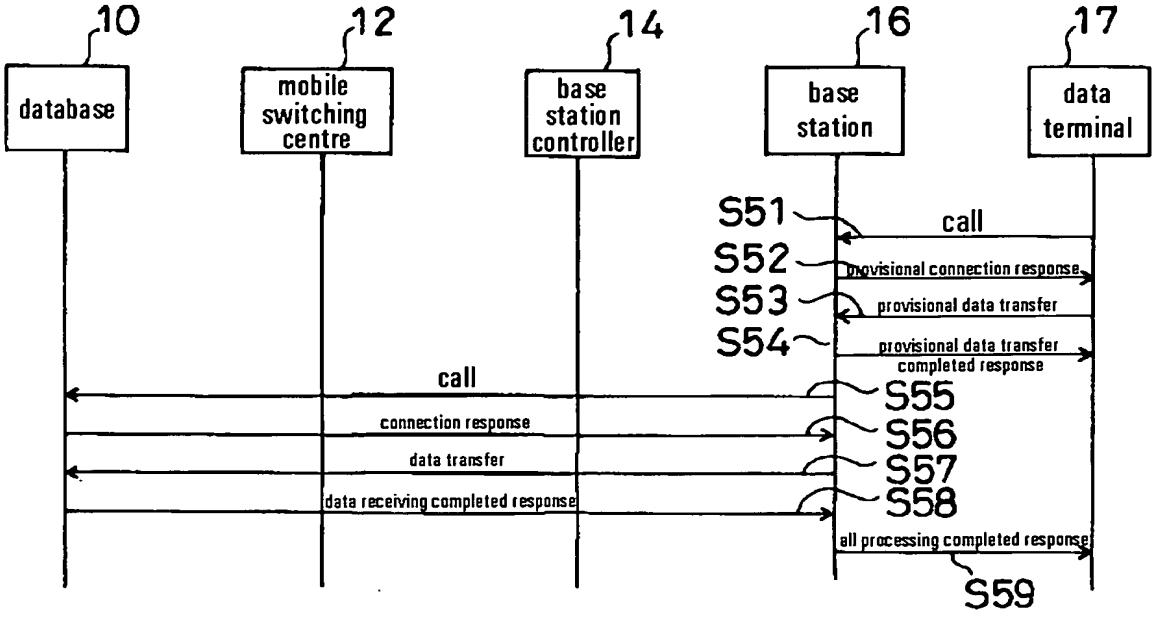

10
12
14
16
17
database
mobile switching centre
base station controller
base station
data terminal
call
S41
provisional connection response
S42
provisional data transfer request
S43
provisional data transfer
S44
provisional data transfer completed response
S45
S46
call
S47
connection response
S48
data transfer
S49
data receiving completed response
S50
all processing completed response

FIG. 9


10
12
14
16
17
database
mobile switching centre
base station controller
base station
data terminal
S51
call
S52
provisional connection response
S53
provisional data transfer
S54
provisional data transfer completed response
call
S55
connection response
S56
data transfer
S57
data receiving completed response
S58
all processing completed response
S59

TRANSLATOR'S NOTES

1. The Japanese used in this abstract does not indicate plurals, and I have added them for accuracy. In this invention, if the storage device is connected to the mobile switching centre, a single storage device is employed, whereas if the equipment to which the storage device is connected is either the base station controllers or the base stations, then a plurality of storage devices are employed. (Reference to FIGS. 1, 2 and 3 confirms this.)
2. The Japanese terms which I have translated as "mobile switching centre" and "base station controller" are literally "mobile relay centre" and "mobile relay station". My translations are intended to bring the terminology into accordance with standard terminology for these components of a mobile communication system.
3. The Japanese does not indicate number. Given the nature of the various possible embodiments of the invention, "a storage device" here in Claim 1 should be taken as encompassing more than one storage device.
4. The Japanese text has "mobile switching centre 102" here. I have corrected this to "mobile switching centre 12".
5. The Japanese erroneously reads "from location information server 17". I have made the necessary correction.
6. See Note 5.